
Issues Encountered in an Attempt to Implement a Second-Generation Management Information System

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ACCURATE, TIMELY, AND APPROPRIATE INFORMATION is essential to planners and managers in both the public and private sectors. While this axiom has long been accepted, its systematic application to human service disciplines has been slow and difficult. As the scale and complexity of human service organizations have increased, computer-based management information systems (MIS) have been introduced to address internal management needs (1), to respond to demands for accountability accompanied by escalating bureaucratic reporting requirements (2), to justify new resource requests, and to evaluate current programs and plan future ones (3). A MIS is "a systematic method to collect, process, store, retrieve, and transmit the selective information on clients, staff activities, and fiscal transactions that some specific functions of management require" (3a).

Despite the urgent need for sound information, human service administrators often resist the development, application, and use of computer-based manage-

ment information systems. Even with the availability of such powerful and increasingly sophisticated information technologies, few community mental health centers have successfully met their quantitative information needs in a timely and cost-effective manner. We describe the evolution problems of a client-oriented information system at a large decentralized community mental health center to illustrate a number of issues involved in applying a MIS to the human service industry.

Bay Cove Community Mental Health Center

The Department of Psychiatry of the Tufts University School of Medicine was formed in 1963—during a period that saw the uniting of several medical, diagnostic, and treatment facilities into the major clinical units of the Tufts-New England Medical Center. This integration and expansion of the clinical services associated with the medical school coincided with the shift in national priorities toward community mental health and with the Commonwealth of Massachusetts' phasedown of State mental hospitals in favor of community-based mental health centers. Under the new State law, the Boston region was divided into six catchment areas, among them the Tufts Bay Cove area.

The Bay Cove area covers 5 square miles, including a portion of downtown Boston and inner-city communi-

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ties to the south. The area's 87,000 residents are largely working-class whites; it also has significant numbers of Chinese, black, and Spanish populations. A Federal poverty area, Bay Cove is a classic example of neighborhoods struggling with major urban problems and beset with the racial tensions that made it the center of national attention with the advent of court-ordered busing in 1974.

Among the first priorities of the new Department of Psychiatry was the formation of a research and planning group to evaluate community needs. Examination of the planning group's results, combined with the input from the newly formed area board, led to a unique conclusion. Unlike most community mental health centers, Tufts would not build a massive central facility. Rather, it would enhance existing social service agencies, already established and linked to local neighborhoods, to create a comprehensive, diverse, and highly decentralized community mental health center directed toward meeting the needs of each segment of the population.

The TUFTS-STATS System

A major issue facing human service delivery systems is that their particular tasks create unique data-structure and analytic problems that are not encountered in information systems applications in the private sector. In 1967, with the Tufts center in full operation, internal management and external reporting requirements dictated the need for an information system capable of monitoring the services to various client populations. Existing mental health information systems were evaluated, and although each had strong points, none were appropriate to the center's needs. Consequently, a complete systems analysis of client-based information procedures and requirements was undertaken to build the foundation of the TUFTS-STATS system.

The results of this analysis (4) indicated that client-based information requirements had little in common with most commercial transaction-based information systems. The units of analysis in the data base of mental health programs range from client visits (encounters), client episodes (admissions), to individual client's multiple admissions. Since episodes can extend through reporting periods, a successful system must have the capability for tracking individual clients over time. Also, the same clients can have simultaneous admissions to different components, with different treatments, as well as with different combinations of movement across treatment components. Since any aspect of these combinations may be the object of a particular (often unforeseen) analysis, the potential

analytic complexity of even a simple data base can become enormous.

While information technology has experienced rapid development, computer-based human service information systems have been fashioned typically after large-scale business applications, with an emphasis and preoccupation on relatively inflexible computer programs (software) and rapidly outdated machinery (hardware). The systems analysis disclosed that the actual hardware requirements associated with client-based information systems were neither extraordinary nor specialized. The key to dealing with data complexity rests first with the structure of the data input and then with the development of simple but powerful computer procedures (algorithms) capable of restructuring the data in such a way as to allow the execution of analytic tasks with the use of existing, multipurpose, statistical software.

Four basic principles evolved from the systems analysis. First, the system should be composed of a series of separate steps or component parts that could be combined flexibly in different ways to produce desired results (it should be modular). Second, programs and procedures should be designed with an eye to increasingly complex analytic tasks and newer technologies as they become available (upwardly compatible). Third, the collection, storage, and processing of information by the system should mirror the events that take place in the real world (a virtual representation). No further step should be needed at the entry and storage levels to reduce, combine, or reorder the data to meet particular analytic assumptions. Fourth, each event must be linked to specific dates and times (time based). With data structured according to these principles, procedures can be constructed to accomplish any analysis for which there are data in the system.

Based on these principles, data collection forms were constructed to capture data at admission and discharge for each client episode in each Bay Cove treatment unit. New patients were assigned unique identification numbers for use across all episodes (admissions) within the Bay Cove components. Data collected included date of admission, basic demographic descriptors, referral and presenting problem, date of discharge, treatment received, and outcome. The data were collected by the staffs of the treatment units.

We decided not to invest in computer hardware other than standard keypunch equipment; thus, we could shop for the most efficient and cost-effective computer services on the open market. Simple computer proce-

dures were devised to permit entry of data at the time of admission and yet link discharge data to the proper episode at date of discharge, often during a subsequent reporting period (5). With this simple but highly flexible approach, all statistical information and government reporting requirements for the entire Bay Cove Mental Health Center were met at minimal cost.

A report was generated by computer annually on about 20 treatment units. This report provided a comprehensive summary of the volume and characteristics of the caseload in each component. Also, a 50-page summary report was produced on all clients across components to provide planning information, as well as the information needed to complete State and Federal reports. Typically, a number of additional ad hoc research and planning reports were produced to meet special requests.

The annual cost for the required computer time, at standard service bureau rates, averaged \$500, which included the cost of data updates and supplies. At a rate of 8,000 new admissions a year, about 3 months of a data clerk's time were spent in processing the forms and assigning case numbers. Key punching, performed at standard rates, cost about \$1,500 a year. System updates, maintenance, and operating time required 2 months a year. Additionally, 3 months of professional time were spent per year in administration, report preparation, and interface with internal and external agencies. The salary and support costs for the core operations unit and staff (including information systems manager, research analyst-methodologist, research assistant, data clerk, and clerk typist) averaged \$75,000, a year. It should be noted, however, that the unit staff performed additional tasks that were unrelated to the TUFTS-STATS system.

Need for a Second-Generation System

The TUFTS-STATS system, with minor updates and an occasional addition of new procedures to meet specific applications, served its purpose for a decade, 1967-77. Although a decade is generally the anticipated lifespan of any computer system, the system might have continued to meet the center's needs if needs and demands had not changed.

The demands on a public sector MIS, to an even greater extent than those in private industry, are frequently shaped by constant external government mandates that tend to be unpredictable, inconsistent, and seemingly capricious. Bay Cove, like most community mental health centers, was being subjected to

an increasing array of private and government reporting requirements. Both the State and Federal governments had revised and expanded their statistical reporting requirements in ways that were inconsistent with the data capture procedures of the original system. The number of administrative agencies having the authority to request data had increased sharply. Some agencies were demanding information that others had forbidden the center to collect (for example, requests for information on race, ethnicity and other sociodemographic variables). Furthermore, the complexity of the center's administrative structure had grown geometrically with the number of components, since each component had a different array of funding sources and different administrative relationships with private and public sponsoring agencies. Even the definition of the "center," for reporting purposes, varied from situation to situation and from time to time.

By 1978, the system contained data on some 50,000 episodes of more than 30,000 clients. The center itself had grown to more than 40 reporting components. Although this amount of data did not begin to approach the storage and analytic capabilities of TUFTS-STATS, the 10,000 episodes entered annually and the reports generated for dozens of components caused us to reconsider the method of data entry, processing, and the kinds of reports produced. While the number of components had steadily increased, the same reports were being produced for each reporting component as had been generated for the few original components. The result was mountains of unused computer printouts.

The 10-year data base on all treatment episodes created a potential research resource for administrative and academic applications. Requests for statistical reports varied widely. In some instances, administrators needed to know the patterns of service use by a specific client group; for example, those who may have been seen simultaneously by a treatment agency outside of the Bay Cove area. In other cases, requests for statistics on clients having particular combinations of characteristics were easily met from the master data base by use of standard options in the statistical modules. Such an approach proved useful in computing the cost effectiveness of various special services, for example, a proposed crisis hostel project. To document a request for certification of need, we examined the patterns of facility use over a prescribed period. Special data selection and pre-processing algorithms were created to pass the required data to a generalized statistical module.

The most demanding requests were for analyses of different patterns of service use by subsets of the larger population, for example, as in a basic research study of the nature of chronic schizophrenia. In this study, the data had to reflect individual clients rather than episodes, and since the clients had different periods at risk the study required more sophisticated analysis. During 3 years, 1975–78, 24 special requests for analyses were received. Most of these requests were easily accommodated during the routine annual analyses; the remainder required special initiatives. Additionally, as more sophisticated applications were demonstrated, subsequent requests tended to reflect a willingness by administrators and program directors to use more advanced approaches and analytic concepts.

Although we had little difficulty in performing the necessary data manipulations and analyses with the system, the results began to reveal inconsistencies and anomalies in the data. These anomalies were traced to a series of quality-control problems that ranged from misunderstandings and inconsistent levels of cooperation at the points of data capture in the individual components to clerical and procedural problems associated with personnel changes in the evaluation group responsible for processing the input data. These irregularities had little impact on aggregated statistics; however, individual research applications, often drawing on small and highly select subpopulations, were seriously compromised by a lack of precision (6).

Finally, 10 years had brought about significant changes in the state of information technology. These changes ranged from the development of new hardware, software, and conceptual approaches to major shifts in the cost structures associated with each of these elements. All of these factors combined to make the re-evaluation of TUFTS-STATS timely.

Systems Review and Attempted Resolution

Human service delivery systems can be, and often are, complex federations of heterogeneous components. Bay Cove is an excellent example. Each component's relationship to the center, as well as the relationships among components, are governed by formal and informal administrative constraints that would have to be reconciled and accommodated by any unifying information system.

From our experiences at Bay Cove and our knowledge of similar undertakings (7–14), we concluded that a successful outcome for a second-generation system could result only from the broadest possible representa-

tion in the review and decision-making process. A task force was formed, and regular weekly meetings with specific agenda were scheduled. This task force included not only the systems analyst responsible for the systems design and the administrator responsible for implementation and data entry into TUFTS-STATS, but also senior members of the center's administration, representatives of the clinical services, component administrators, basic researchers, and planners.

The task force's first issue was to decide to what extent the system could become a MIS that included not only client episodes but also client visits, staff activities, billing, and overall fiscal management. Although various aspects of a proposed MIS could be implemented at individual components, the use of a central system to address these issues was untenable because administrative authority over staff varied widely from one component to another and many components already had decentralized billing or cost-recovery mechanisms. Even in the unlikely event that all components directors agreed to participate in a central personnel and fiscal management system, the wide range of services and approaches offered by them would have made comparisons across the components virtually meaningless.

The reality that a true MIS was impossible for us did not bode well for the future of the system. We decided to approach the systems review from the perspective of the client information and reporting requirements mandated by government and administrative bodies. The question asked was, What reports are needed? A review of the reporting requirements specified by government agencies provided a lucid demonstration of just how many different and inconsistent approaches can be taken to address the same topic. Not only were the questions addressing common topics presented inconsistently, but the range of topics occasionally seemed to have little relationship to the center's activities (15).

The task force informed each of the mental health center's government and administrative bodies of the nature and scope of the task force's activities. When discussions were begun to explain the need for changes in the current information-gathering system, and possible alternative ways of meeting them, more serious problems arose. Some of the regulatory agencies' "information specialists" lacked a basic understanding of information management, making it difficult to negotiate specific issues. The representatives of the information systems groups at other agencies, although clear about their requests, were reluctant to participate in the systems review process.

Most regulatory agencies were willing to negotiate acceptable procedures for meeting their information needs; however, the escalation of meetings, bureaucratic entanglements, and personnel changes, as well as changing information requests, hampered the task force's work. Although bureaucratic requests for information can be fluid, and their rationale often elusive, the task force and center staff recognized their obligation to honor reasonable requests for data from legitimate sources. But to follow each of the requests literally, or to defer any decision about systems development until all of the inconsistencies in regulatory requests could be resolved, would have been unproductive and would have compounded any existing problems. We decided to proceed despite the obstacles.

The success of any MIS rests on the content and structure of the data base, in the way in which the functions and tasks of the system are conceptualized, formulated, and performed, and in its administrative usefulness. These aspects of the system most closely touched the daily activities of administrators, but they were also the most difficult aspects with which to work. We quickly discovered that achieving agreement on even the simplest issue could become a diplomatic task of herculean proportions. For example, the decision to include any item of information on the systemwide data collection form (as well as the way the question itself would be worded and structured) required the agreement and cooperation of not only the sponsoring government agencies, but also of the administrators of each component, their record-room managers, their advisory boards, and the associated legal, quality assurance, and regulatory boards.

A major strength of the original information system had been its centralized, mental health centerwide, data-gathering capability that ensured—to the extent possible—uniform information, data security, and controlled distribution of information. The second-generation system (TUFTS-STATS II) would have value only if it were implemented uniformly across components. Arriving at a definition of a core set of admission and discharge information items that would be acceptable to all parties and that would fulfill the internal and external information needs of the mental health center became the major focus of the task force.

When agreement was reached on a core set of information, a number of problems arose in implementing data collection procedures. In the original TUFTS-STATS, information on economic descriptive variables, such as occupation and source and amount of income, was consistently missing. The lack of information

was further compounded by multiple interpretations from center components of the meaning of some information requests (for example, diagnosis and reason for referral). The new data collection instrument was constructed so that one would choose between a limited number of stated alternatives rather than providing handwritten information—for example, circling one of eight source-of-income categories instead of filling in a blank. An instruction manual was prepared and distributed, and a number of reliability checks and administrative decisions were instituted to ensure data uniformity.

Other than meeting known reporting requirements and providing requested reports, administrators could provide the task force with few details regarding anticipated data needs that might require major design modifications. Data needs were difficult to specify in advance, and discussions of possible applications raised more questions than they resolved. For example, a discussion of the number of components the system could expect to accommodate triggered lengthy debate about the future of particular reporting units, the desirability of creating new components to meet specific objectives, and the need to separate or combine particular components to satisfy administrative criteria. Discussions of combining components into center subdivisions for particular reporting purposes led to questions about the political, conceptual, and administrative nature of the center and its units. The decision was made to collect data from every identified center component no matter how small. This decision ensured that information would not be lost. At the same time, the decision allowed for the aggregation of data to meet various reporting requests in a manner that could change over time and meet unanticipated needs. How the administrators might use such information remained unclear.

There was consistent agreement by all parties that the data must be made maximally relevant and accessible to the widest possible range of legitimate users, which implied more frequent feedback to components, tailored to their specific needs, and procedures whereby both administrators and basic researchers could cut through the maze of information and get timely answers to their questions. This was no simple task since much of the complexity and limitations were inherent in the data. A partial solution lay in better interfacing and communication. A new full-time staff position of information systems manager was created to serve two vital functions: (a) to work with components on an ongoing basis at each step of data entry to assure quality control and (b) to be a liaison between the technical system and the user, helping the user formu-

late questions, conceptualize analyses, and interpret results.

Although cooperation, negotiation, and discussions with regulatory agencies, administrators, and clinicians did not always meet the need for specific design criteria, these were critical if the TUFTS-STATS II was to fulfill its mandate. The systems review created an atmosphere in which the system could be understood and viewed with common realistic expectations. The MIS design process had become an exercise in general administrative planning.

The Failure of TUFTS-STATS II

Many human service programs are in a position that requires them to adapt to the needs of their information systems. However, there are no conceptual, technical, or administrative reasons why systems cannot be made responsive to the requirements of the programs they serve. It became apparent to us that the process of decision making and debate would continue for some time. The key to the success of the second-generation system would have been its simplicity and adaptability. The evolving systems design and programming for TUFTS-STATS II was based as much on sound general-design criteria and experience with traditional applications in comparable settings as on any specific-design criteria that evolved during the review and planning process. The original concepts and procedures that formed the basis of TUFTS-STATS were easily adapted to meet the objectives of TUFTS-STATS II. The computer programs and procedures were written to take into account significant changes in information technology, as well as new procedures for data collection and entry and quality control (16).

Despite the lengthy review process, the TUFTS-STATS II system was not implemented. First, a change in administrative leadership brought with it a rethinking of the collection, management, and use of information throughout the center. Although the computer services cost for TUFTS-STATS II was less than an estimated \$1,000 for fiscal year 1980, the costs for consultation and evaluation unit maintenance were unacceptably high (\$75,000) in view of the underuse within the center of even the most readily available information. Second, regulatory pressure required yet a further redefinition of the federally defined mental health center. From the original rapidly expanding and decentralized multi-agency organizational structure of more than 40 clinical programs that had existed and expanded for 13 years, a smaller, more administratively manageable center was defined to comply with Federal regulations for mental health centers. Third, there

were many quality-control problems within the existing data base, and many future problems were anticipated.

The new mental health center structure sponsored by the Tufts New England Medical Center included only 16 clinical units; all but 5 were units of the medical center. Rather than using TUFTS-STATS II to generate reports to meet regulatory requests for information, we found it feasible to use existing management information system components. Although use of these components would require some additional resources for program directors to obtain information on their units' service delivery patterns, clients' sociodemographic characteristics, treatments provided, and so on, administrators would have the opportunity to more cost-effectively monitor the functioning of the Federal center by developing the smaller but more complete management information system.

Conclusion

This review of the development of a computer-based client information system in a large, decentralized comprehensive community mental health center illustrates the issues encountered in the implementation, application, and survival of such a system. The age of the original TUFTS-STATS system, as well as changing needs and demands, indicated a need for creation of a second-generation information system. This difficult task was undertaken with great care and planning, but we encountered many problems that required negotiation, delay, compromise, and, ultimately, abandonment of the system.

The information needs of human service delivery systems to support effective administration and satisfy external reporting requirements are confusing and inconsistent, and internal information is often controversial and politically sensitive. These factors must be reconciled and shaped in ways that minimize their destructive force and maximize their contribution to program goals. Information systems need not represent major capital investments, nor should they require interaction with a complex and changing technology. Rather, they should be the focus of program planning and development and a major support tool in meeting service delivery objectives.

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SYNOPSIS

ADLER, DAVID A. (Tufts University School of Medicine) and EDWARDS, CARL N.: *Issues encountered in an attempt to implement a second-generation management information system. Public Health Reports, Vol. 96, July-August 1981, pp. 369-375.*

Human service organizations are beset by internal and external requests for information. As the scale and complexity of such delivery systems has increased, the use of computer-based information systems has become a necessity. The evolution

of a client information system in a large, decentralized mental health center is reviewed in this paper to illustrate several critical issues that can be encountered in the application of computer-based technology to human services.

An analysis of the center's existing information system and the development of the data forms and procedures necessary for a second-generation system to meet information needs revealed the unique data structure and analysis problems of human service delivery systems.

These problems were complicated by regulatory agencies' imposition of external reporting requirements that frequently were unpredictable and inconsistent. Finally, planning and negotiations with the participation of all involved parties demonstrated that formal and informal administrative constraints and conflicting interests within human service organizations must be accommodated or a system may fail. All of these factors combine to highlight both the problems and the need for highly flexible multipurpose information systems.